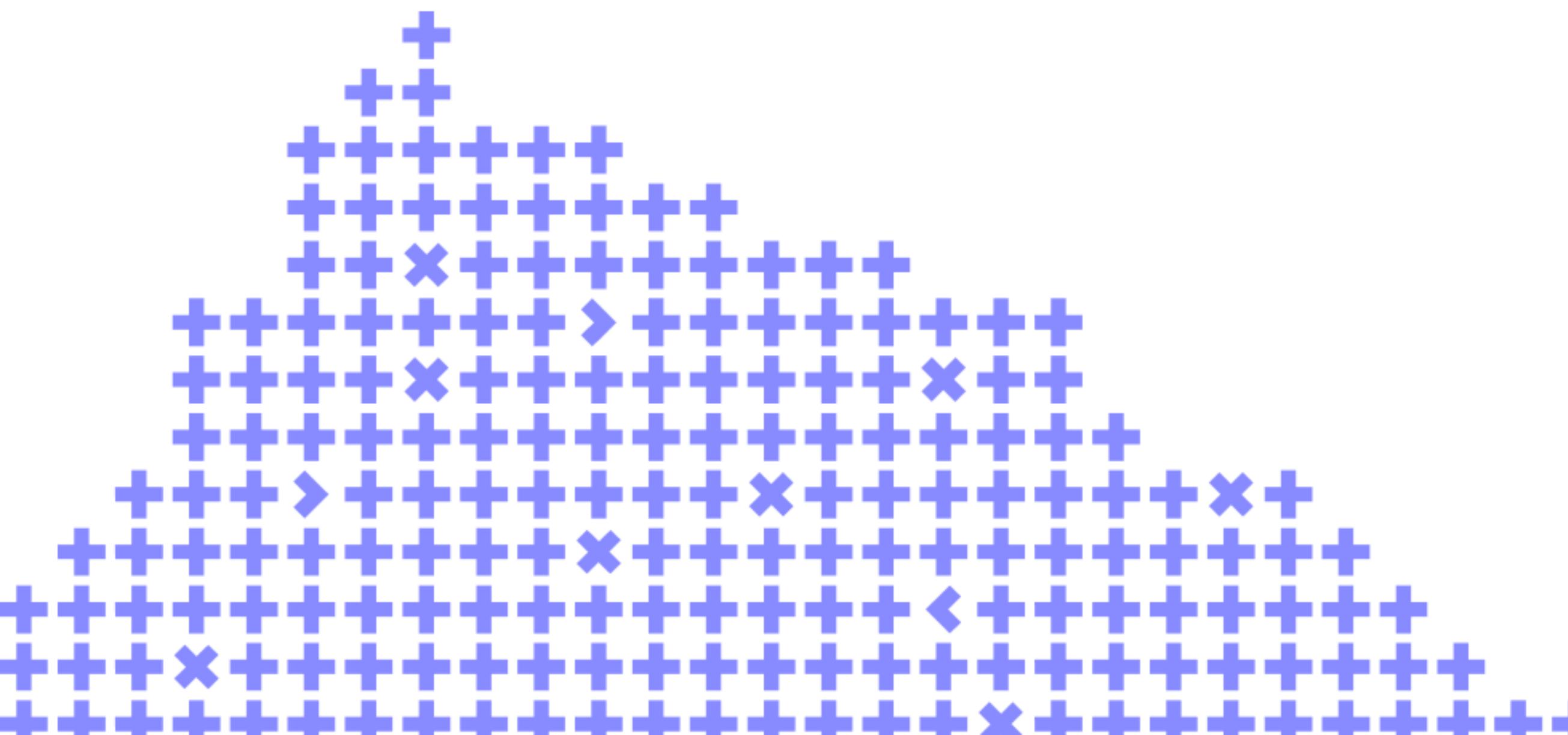


Things they never tell you about video streaming

Anton Kortunov



Co-organizer

Yandex

Yandex

Modern history of Yandex
live streaming services



2019

NHL

Stream all games (up to 13 at the same time)

Deep integration with professional TV studio

2018

FIFA World cup

1 TBps of video

1M of viewers online

2018

Winter Olympic Games

The first major live event

2017

Start of Yandex Efir project

Live TV channels

1. Why does sound matter?

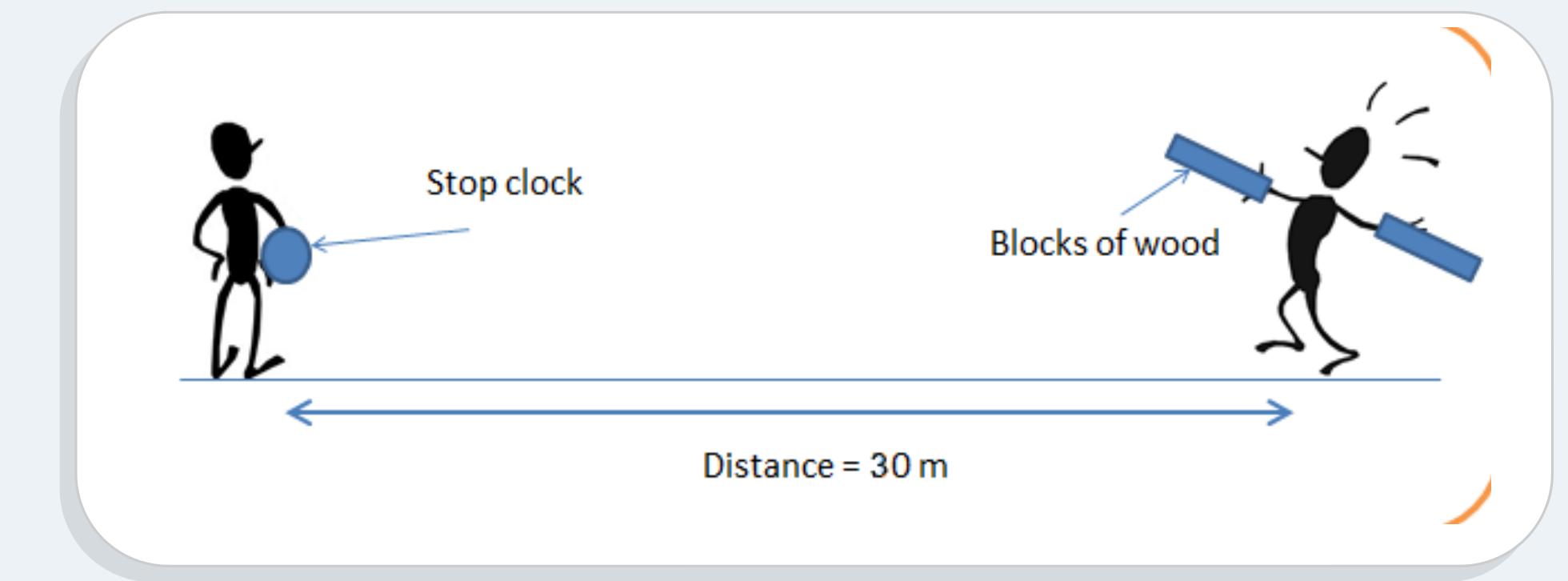
2. Why does shutter matter?

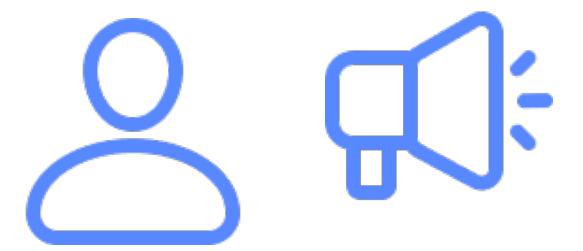
3. Interlaced videos

4. Frame Rate Conversion

5. How to preserve quality?

Speed of sound is ~ 340 m/s
100 m/s delay equals to ~ 30 m





Lip sync

- OK if audio delays from video,
up to 4 frames
- Not OK if video delays
from audio, no more
than 1 frame allowed







1. Why does sound matter?

2. Why does shutter matter?

3. Interlaced videos

4. Frame Rate Conversion

5. How to preserve quality?

How to control Exposure Value

1

Aperture

2

Shutter speed

3

ISO

4

ND filters

Video is not a
sequence of images!
Motion blur matters!

How to control Exposure Value

1

Aperture

2

Shutter speed

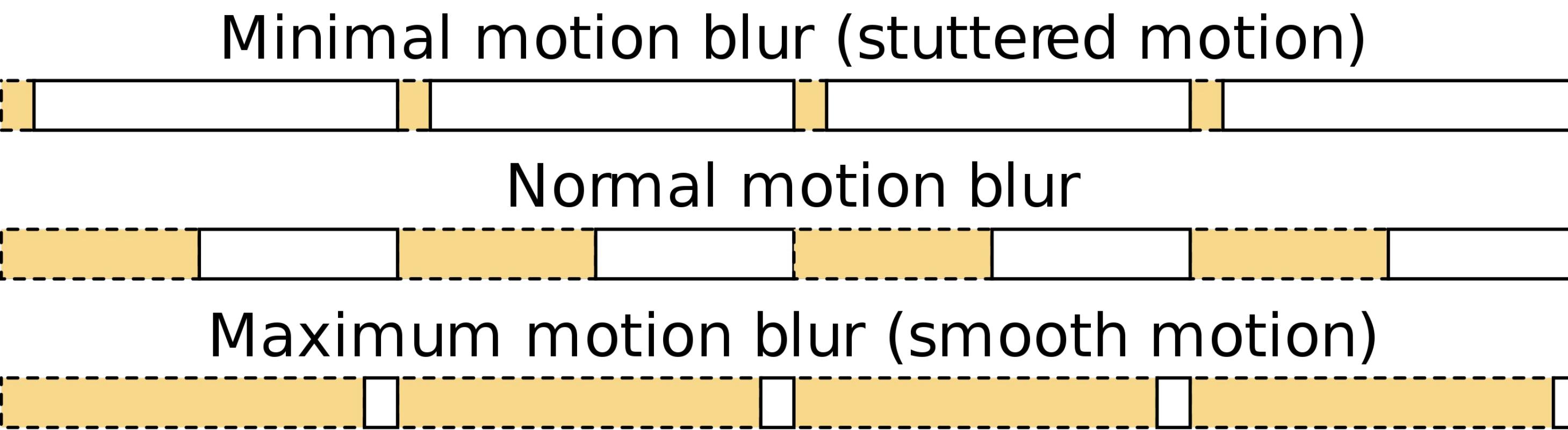
3

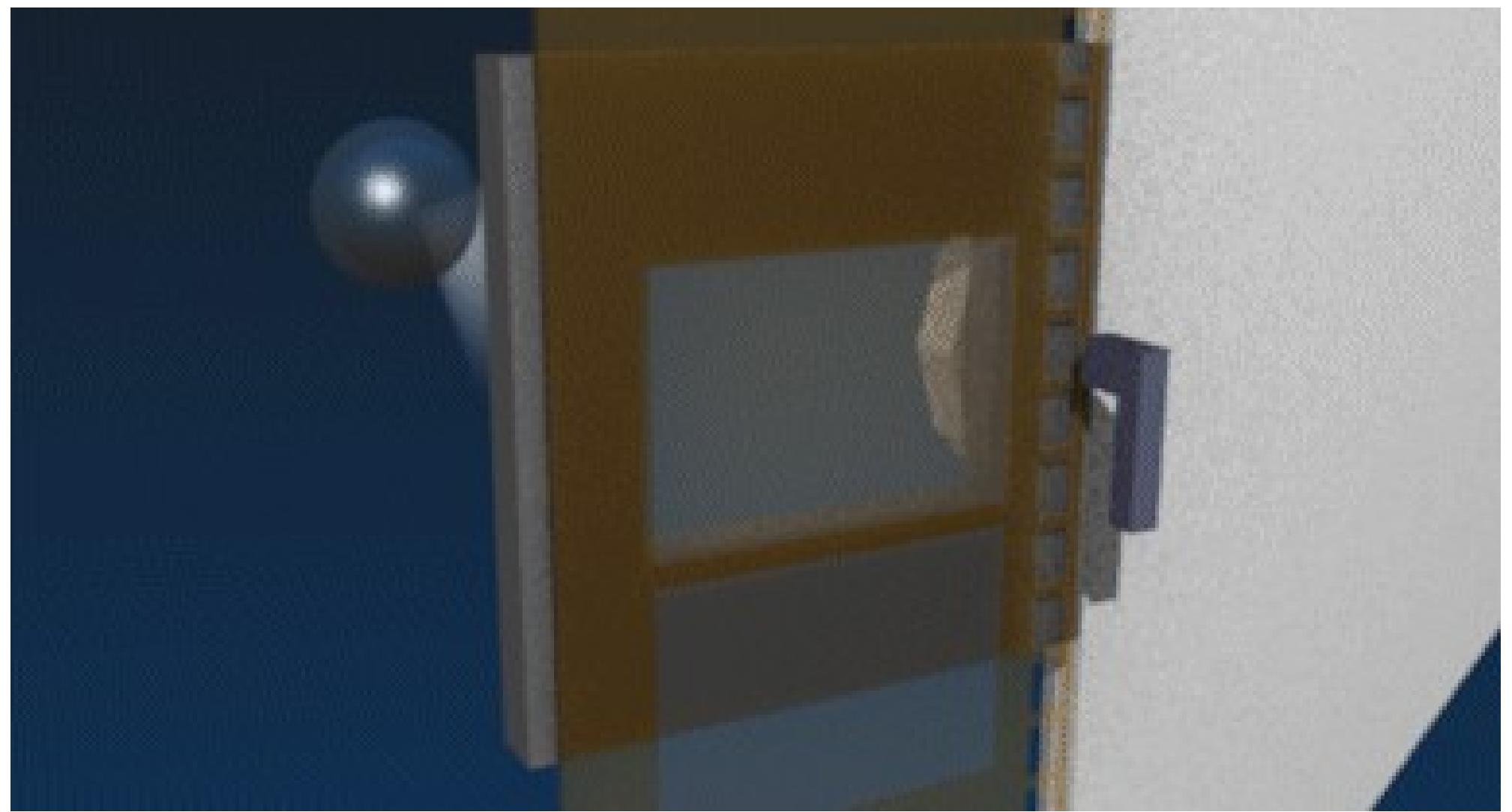
ISO

4

ND filters

How to control motion blur





Old cinema rotary shutter

- Controls motion blur
- Normal value is 180°
- Could be recalculated according to FPS





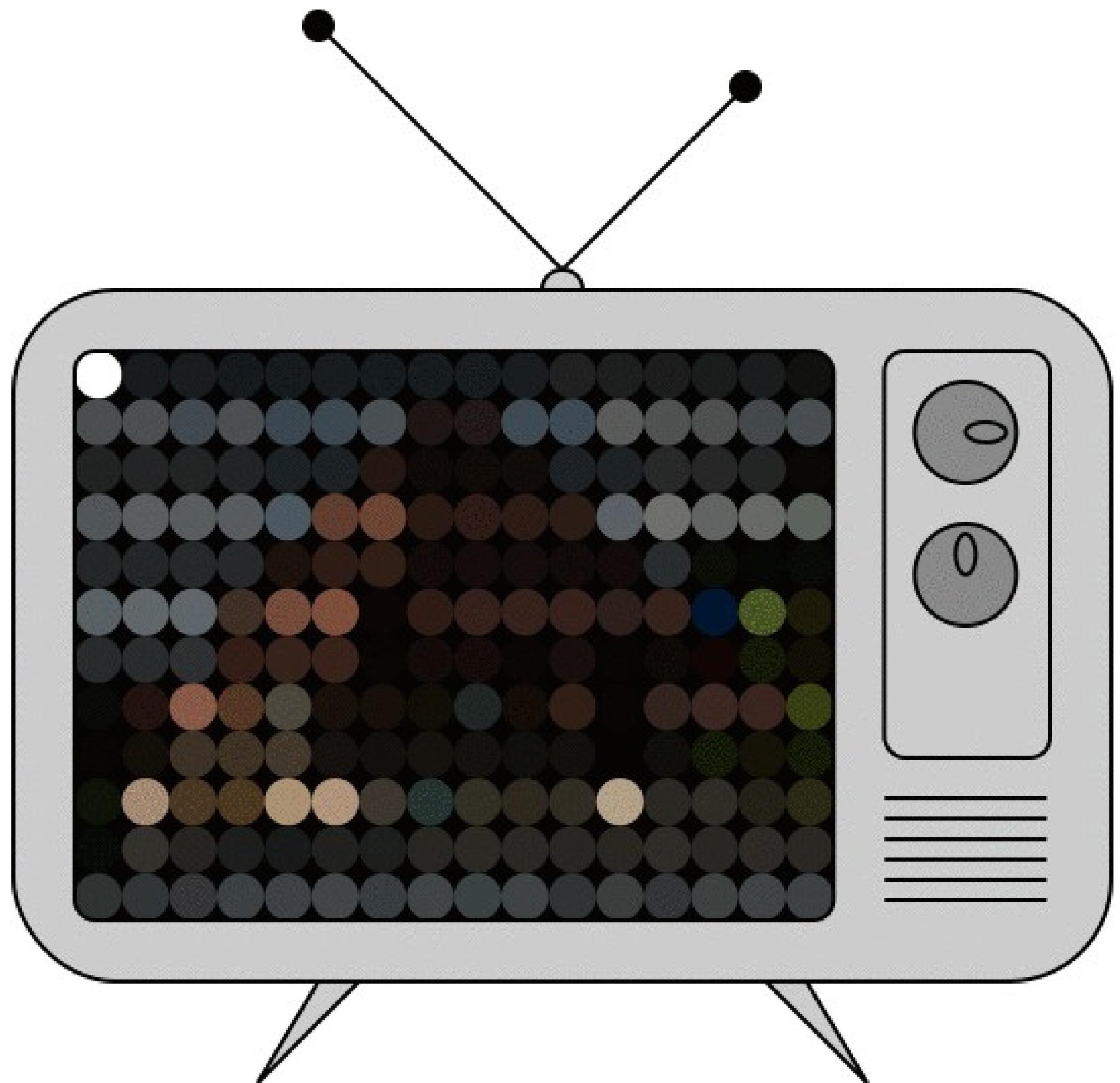
1. Why does sound matter?

2. Why does shutter matter?

3. Interlaced videos

4. Frame Rate Conversion

5. How to preserve quality?



Legacy technology

- Invented in 1927
- Beautiful hardware hack
- Requires pixel accuracy
- Does not work in the Internet

Interlaces videos

1. 2 fields per frame
2. Increases temporal resolution
3. Increases spartial resolution
4. Works fine on old CRT TVs

Why should you care?

1

Camera shutter refers
to 50FPS

2

Deinterlace to 50FPS
to prevent stuttering

3

Obey field order

► A 973 min MP4 Remote
B MP4

STBY 59.94P

21:41:20.05 P







1. Why does sound matter?

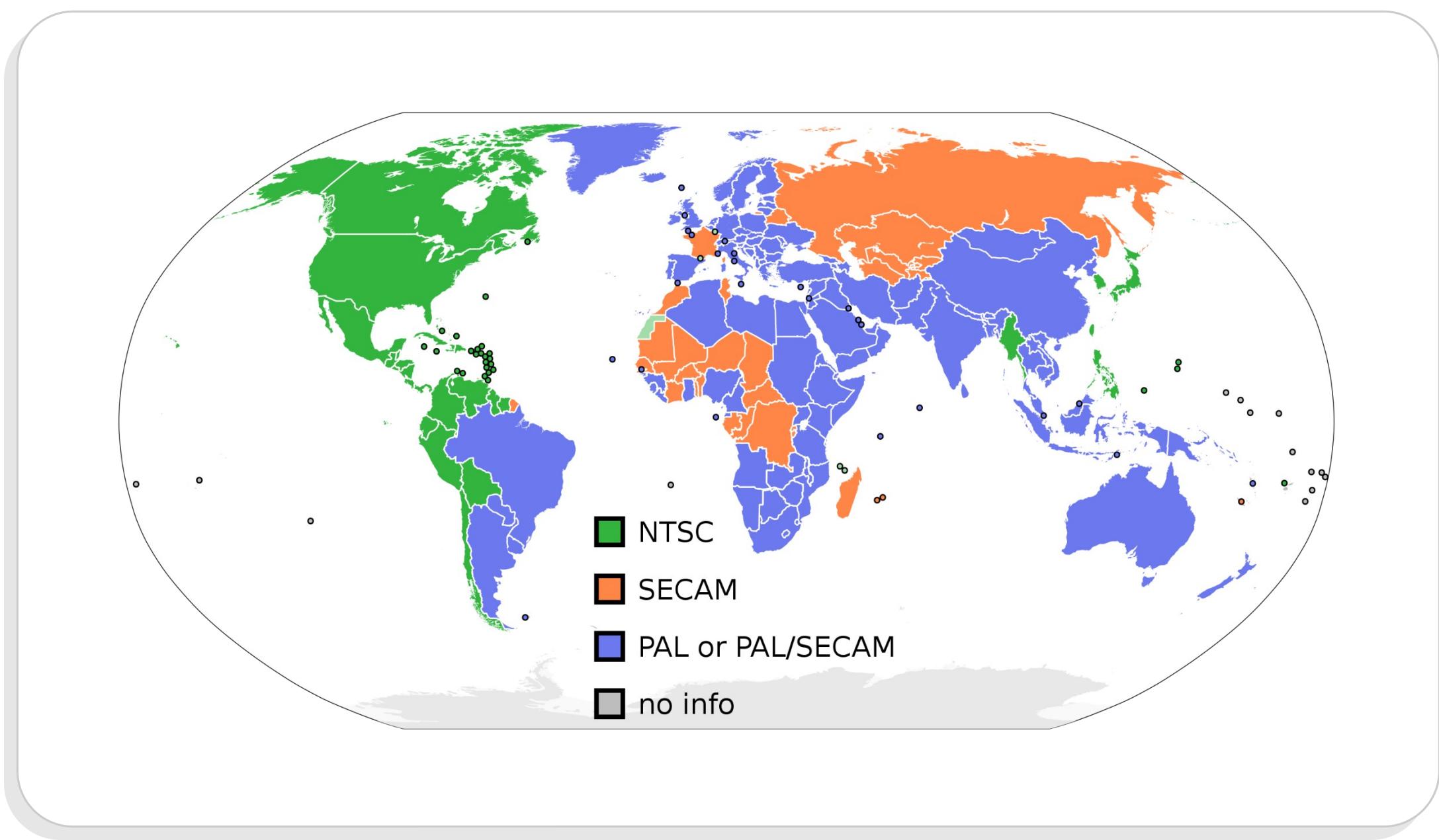
2. Why does shutter matter?

3. Interlaced videos

4. Frame Rate Conversion

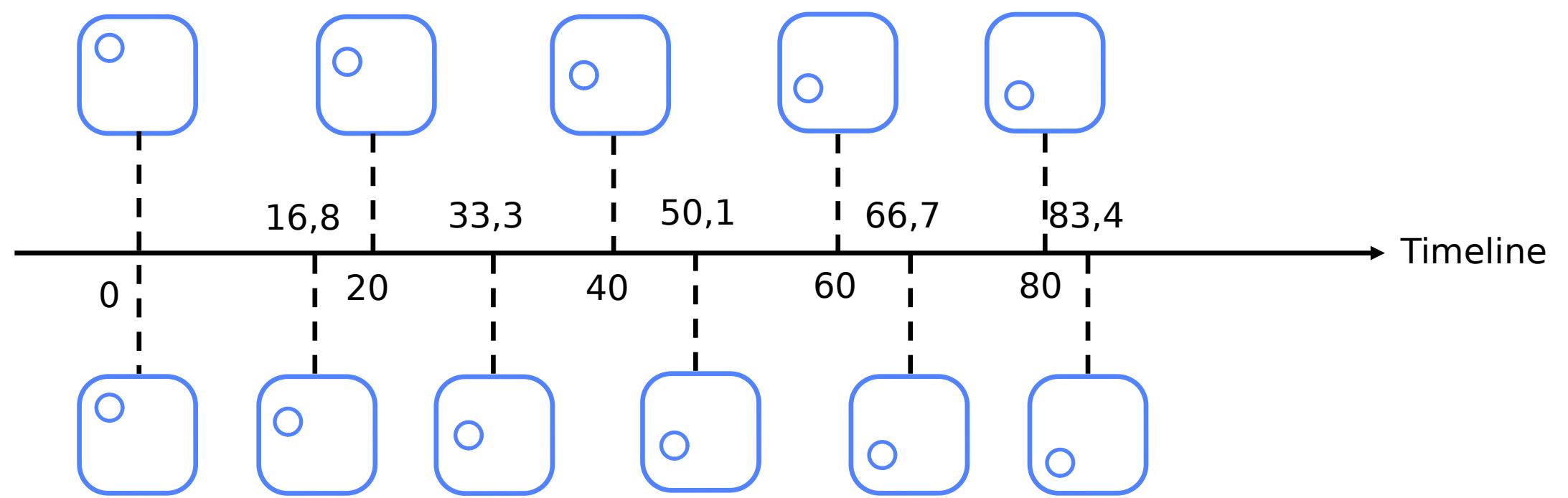
5. How to preserve quality?

Avoid if you can



Map of FPSs

- NTSC is 59.94FPS (60i)
- SECAM is 50FPS (50i)
- PAL is 50FPS (50i)



For each 5 frames of 50p video there is 6 frames of 60p video

Only 1 frame of each batch corresponds to the same timestamp

Possible artifacts

1

Ghosting

2

Stuttering

3

Blurred fast moving
objects



► A 227 min MP4  Remote
B  MP4

STBY

50.00P

21:41:20:05 P

YCC420 8 bit
3840x2160

30 mm

AF   0
NORM1
CP 

LM

1 2

FAN

-  +

K 5880K ±0CC

F 3.5 ISO 400

1/100

1. Why does sound matter?

2. Why does shutter matter?

3. Interlaced videos

4. Frame Rate Conversion

5. How to preserve quality?

How to save quality

1

Get all video in one system
of coordinates

FPS, size, audio discretization
rate

2

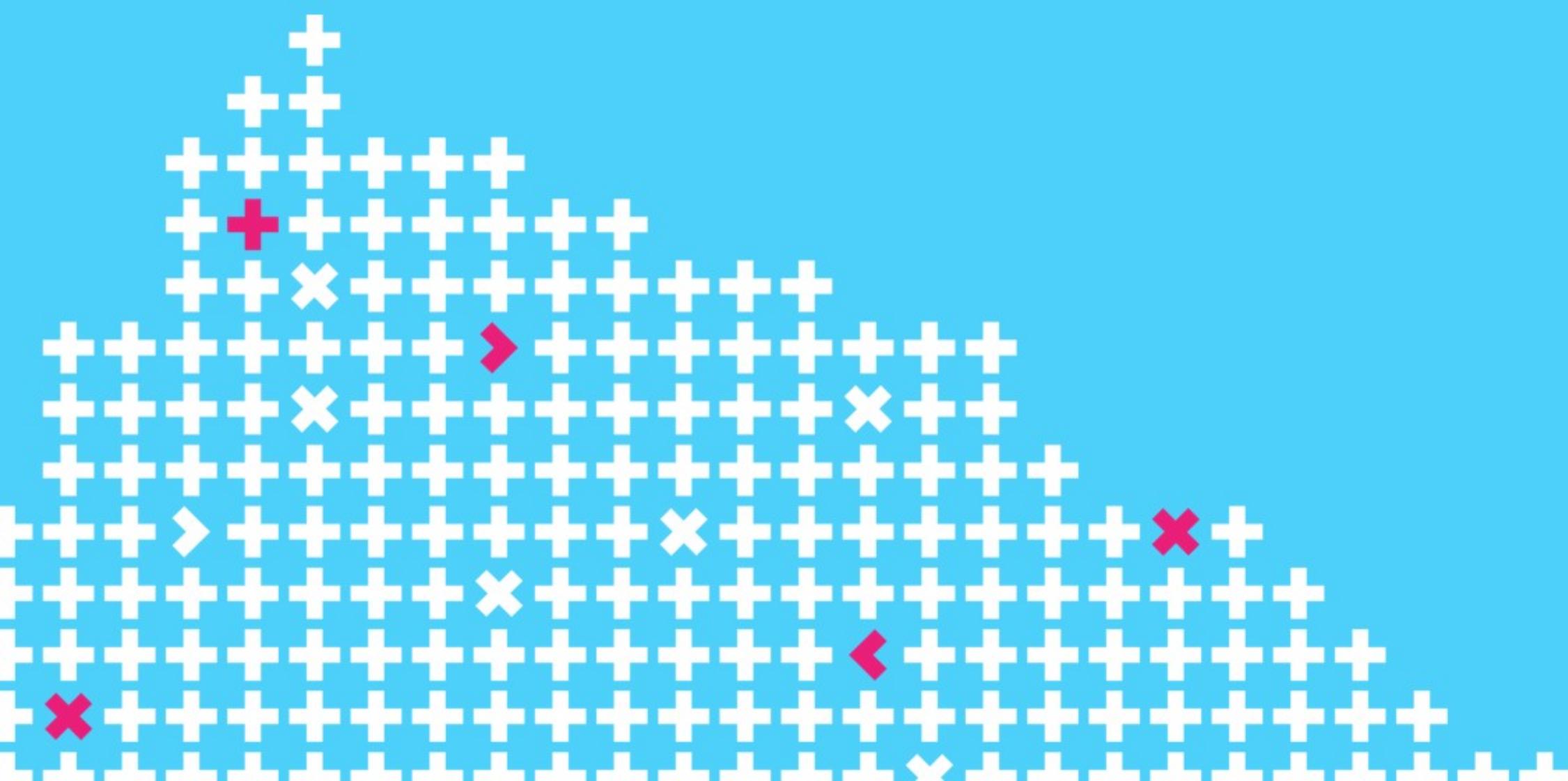
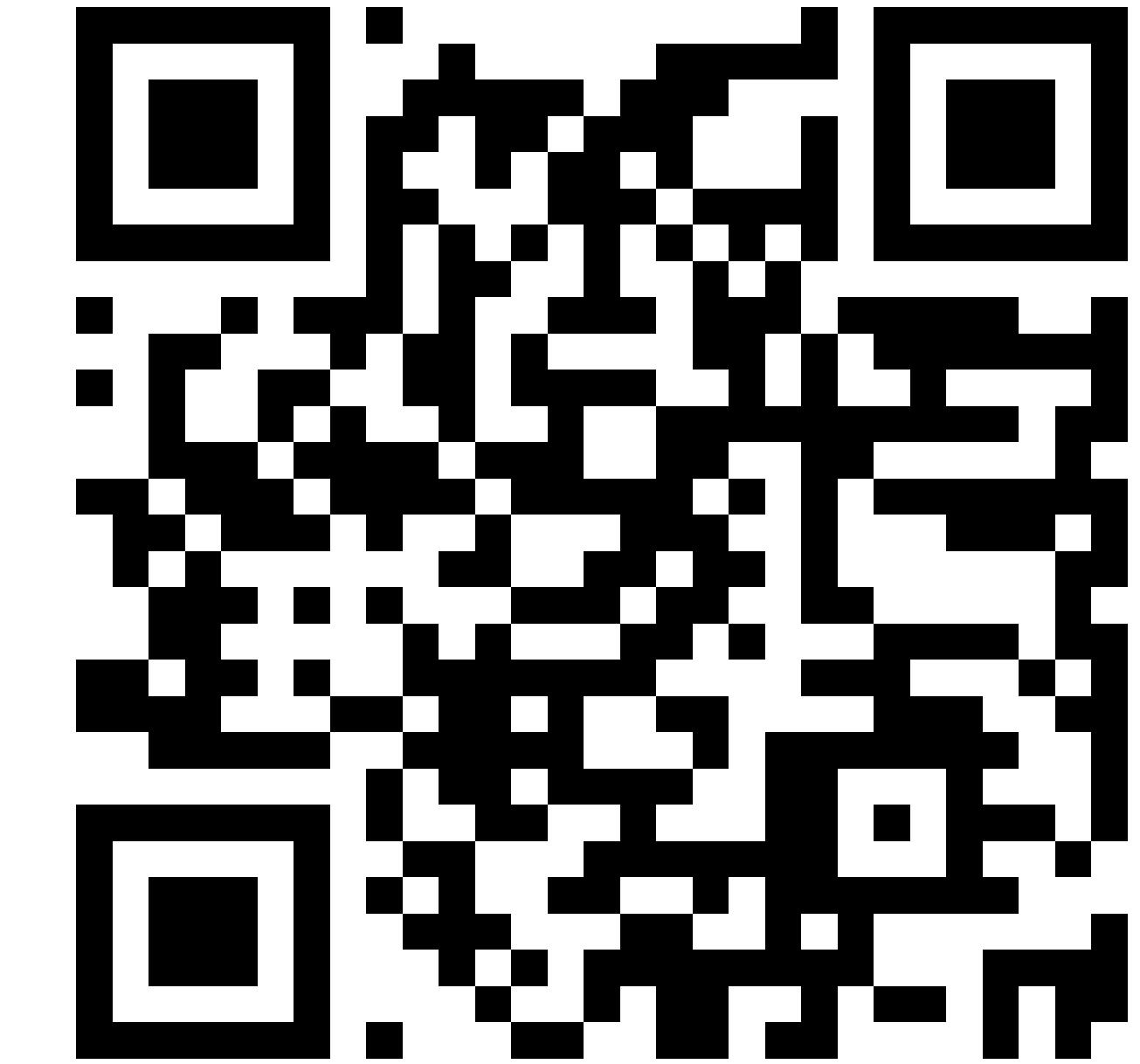
Respect timestamps from
source

3

Watch result with your
own eyes

Leave your feedback!

You can rate the talk and give a feedback on what you've liked or what could be improved



Co-organizer

Yandex